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Cod Catch Results 2002: Year Six of the NAFO Subdivision 3Ps Fall GEAC Surveys

Résultats de captures de morues de l'année 2002 : Sixième année des relevés d'automne du GEAC dans la sous-division 3Ps de l'OPANO

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ABSTRACT

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys each fall from 1997 to 2002 directed at cod. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the sixth such GEAC survey in 3Ps following on the previous 1997-2001 surveys (CSAS Research Documents 99/20, 99/34, 2000/024, 2001/012, and 2002/037). One trip to perform the 2002 survey was carried out from 23 November to 3 December 2002. These dates correspond well with the late-November and December time periods for the earlier five years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of cod abundance and biomass, including age distribution estimates, and interpretation of results are presented.

The 2002 survey indicates a total abundance estimate for 37.9 million cod which is down by 14% from the 2001 estimate of 44 million but is still consistent with the 2000 estimate of 37.7 million. The total biomass estimate for 2002 is 92 ktonnes which is up 11% from the 2001 estimate of 82.7 ktonnes but is still less than half the 187 ktonnes estimate of 2000. The larger 2000 biomass estimate is due in large part to increased numbers of larger cod, age 6 years and older, and in particular age 10 and 11, caught in 2000 that were not present in the 2001 or 2002 surveys. Nevertheless, the appearance of large numbers of smaller fish aged 3 and 4 in 2001 continued in 2002 with 80% of the estimated total abundance being attributable to age 4 and 5 year old cod. While most of the cod caught in 2001 were located in the shallower depths of the St. Pierre Bank, the greatest number of cod in the 2002 survey were located in the deeper mouth and entrance of Halibut Channel where most of the large catches of the earlier survey years were located.

RÉSUMÉ

Pour améliorer la base de données de recherche sur les pêches dans la sous-division 3Ps de l'OPANO, le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) a financé des relevés de la morue effectués chaque automne de 1997 à 2002. Ces travaux ont pour but d'obtenir une série de relevés annuels automnaux dans 3Ps afin de compléter les activités d'évaluation de la ressource que mène actuellement le ministère des Pêches et des Océans (MPO). Le GEAC a financé et réalisé les relevés avec l'aide scientifique du MPO, qui a fourni des conseils scientifiques pour la conception et la réalisation d'un relevé aléatoire stratifié et des échantillonnages connexes. Les données ainsi recueillies ont ensuite été analysées pour le compte du GEAC et en vue de les transmettre au MPO pour qu'il les entre dans ses bases de données et s'en serve pour ses travaux d'évaluation. Il s'agit du sixième relevé du genre effectué par le GEAC dans 3Ps, après ceux de 1997 à 2001 (documents de recherche du SCES 99/20, 99/34, 2000/024, 2001/012 et 2002/037). Pour réaliser le relevé de 2002, une sortie a été effectuée du 23 novembre au 3 décembre 2002. Ces dates concordent bien avec les périodes de la fin novembre et de décembre au cours desquelles les sorties ont été effectuées les cinq années précédentes. Pendant la sortie, les détails sur le mouillage des engins et les fréquences de longueur ont été enregistrés dans le système FFS du MPO, et des otolithes ont été prélevés pour déterminer l'âge des prises. Ce document présente des statistiques de captures, la distribution des longueurs et des âges, des estimations par analyse stratifiée de l'abondance et de la biomasse, notamment des estimations de la distribution par âge, ainsi que l'interprétation des résultats.

D'après les résultats de ce relevé, l'abondance totale en 2002 a été estimée à 37,9 millions de morues; bien que cela représente une baisse de 14 % par rapport aux 44 millions estimés en 2001, ce chiffre est comparable aux 37,7 millions estimés en 2000. La biomasse totale a été estimée à 92 kt en 2002; même si ce chiffre représente une augmentation de 11 % par rapport à la biomasse estimée de 82,7 kt en 2001, il est encore moins de la moitié de la biomasse estimée de 187 kt en 2000. Cette dernière est en grande partie imputable à la présence dans les prises de 2000 d'un plus grand nombre de grosses morues, âgées de 6 ans et plus, en particulier de morues de 10 et 11 ans, ce qui n'était pas le cas des relevés de 2001 et 2002. Malgré cela, le grand nombre de petites morues de 3 et 4 ans présentes dans les prises en 2001 a continué à se manifester en 2002, 80 % de l'abondance totale estimée étant imputable à la présence de morues de 4 et 5 ans. Alors que la plus grande partie des prises de 2001 ont été récoltées dans les eaux peu profondes du banc Saint-Pierre, les plus fortes prises en 2002 ont été réalisées dans les eaux profondes de l'embouchure et de l'entrée du chenal du Flétan, où ont aussi été réalisées la plupart des fortes prises lors des premiers relevés de cette série.

INTRODUCTION

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys each fall from 1997 to 2002 directed at cod. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the sixth such GEAC survey in 3Ps following on the previous 1997-2001 surveys (CSAS Research Documents 99/20, 99/34, 2000/024, 2001/012, and 2002/037 [1-5]). One trip to perform the 2002 survey was carried out from 23 November to 3 December 2002. These dates correspond well with the late-November and December time periods for the earlier five years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of cod abundance and biomass, including age distribution estimates, and interpretation of results are presented.

Under contract to GEAC, AMEC has taken the data logged using the DFO FFS system, combined with the aged otiliths, created digital data files appropriate for inclusion in the DFO (VAX computer system) databases, and performed a first analysis of the survey results. This document presents these results.

Methods and Materials

A Stratified Random survey was carried out in 3Ps by the *M.V. Pennysmart*. A summary of the trip is presented below.

Trip 7: Stratified Random Survey
Trip 7 was carried out from 23 November to 3 December 2002. This time period is consistent with the 1997-2001 stratified random survey sets. The *Pennysmart*, the same boat as in the previous surveys and with the same captain, sailed from Marystown for operation in 3Ps, St. Pierre Bank, Halibut Channel, and Green Bank. Figure 1 shows a map illustrating the location of the strata surveyed. The survey was directed at cod, American plaice, and witch flounder. Set details, length, sex, and otolith information were sampled. Weather and sea conditions were generally favourable although time available to complete the survey was cut short at sea. Efforts were made to optimize the survey set coverage in the time available; however, a reduced total of 75 successful sets were completed. This is comparable to the 73 successful sets from 2000 (in which approximately five days of survey time was lost due to poor weather and sea conditions) but lower than the other four survey years which averaged 88 successful sets.

Tows of duration 30 minutes using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined) were conducted. The trawl was fitted with rock hopper foot gear and Bergen #7 trawl doors. The 30 minute tows were commenced once the net reached the bottom.

Performance of the trawl was checked onboard using SCANMAR sensors: bridge display of doorspread and net opening (headline height) was visually monitored and these measurements together with trawl depth were noted every five minutes on the written bridge log for each set. For several sets, the doors sensor was moved to obtain a measure of the trawl wings. The doorspread (or wingspread), opening, and clearance measurements were logged to computer disk using Seatrawl software. The trawl gear and configuration were identical to those used in the 1997-2001 surveys.

A total of 75 successful stratified random tow sets were completed. One set was unsuccessful: the gear was badly damaged and catch affected in set 7.

Data were logged using FFS with the length and otolith sampling carried out on board. The resulting ages were input to create an age and growth digital file.

Results and Discussion

Shore-based Analysis
The set details and cod length frequencies were exported from FFS to create ASCII data files. The age and growth data were keyed in following completion of the otolith aging by Norm Batten (the otolith reader for 1997-2001 as well).

The cod were sampled in 1 cm length groupings and all ratio/percentages of catch measured were applied.

ACON plots of the spatial distribution of catch weights are presented in Figure 2 and include the corresponding catch results from the 1997-2001 surveys. The only catches of any size in 2002 were located at the southern entrance to the Halibut Channel. Few cod were caught on the western portion of St. Pierre Bank in contract to 2001 when the majority of large catch sets were located there.

Table 1 presents a summary of the cod set details and catch numbers and weights. The mean cod catch for the 75 stratified random sets is 47 fish and the mean catch weight is 114 kg (compared with 48 and 90 kg in 2001 and 72 and 370 kg in 2000). The total number of cod caught was 3,543 in 2002 compared with 4,340 in 2001 and 5,247 in 2000. The total catch weight was 8,571 kg in 2002 compared with 8,195 kg in 2001 and 26,992 kg in 2000. The largest catch of 2877 cod and weight 7,020 kg was from set 57 in a depth of approximately 146 m at the mouth of the Halibut Channel.

For 2002, just five sets had catches over 100kg compared with 10 sets in 2001. In 2002 there were two sets of 200 kg or more and one set of more than 1000kg compared with 2001 in which there were eight sets greater than 200 kg and two sets greater than 1000 kg.

Figure 2a shows the eight largest set catch weights for each of the six survey years. Note that the largest sets 8035 kg in 1998, 17083 kg in 2000, and 7020 kg in 2002 are greater than the 5000 kg scale shown. Other than the one large set in 2002, the next seven largest sets are smaller than in all previous years.

The mean cod weight for all sets was 2.19 kg per cod compared with 1.87 kg per cod in 2001. The mean cod weight for the largest catch set 57 was 2.4 kg.

Gear Performance

The survey gear performance was monitored with SCANMAR units mounted on the net. Measurements were digitally logged with the DFO Seatrawl software and noted every 5 minutes on the bridge log. Doors, opening, and clearance were recorded for most sets. Sensors were moved to measure wingspread for six sets, 43 to 47, and 58. A set of standard Seatrawl range, duplicate observation, and QC checks were applied to the data. Seatrawl files were missing or incompletely logged for nine sets and for these any bridge log values noted on the set sheets were used to compute mean values where possible.

Figures 3a and 3b present the resultant doorspread and wingspread statistics for each set. The mean +/- one standard deviation are shown. The mean doorspread is 71 m, the same as in 2001, and comparable to 72 m in 2000, and 74 m in 1999. A NETMIND system was used in 1999. The doors performance in sets 4, 6, 20, 51, 52, and 57 are suspect and these sets are not presented in Figure 3a. They range from 14 to 49 m and average 27 m. If one removes these sets from the calculation, the mean becomes 75 m. Set 57 is the largest catch set. Only one 5-minute average of doorspread equal to 89 m was noted on the bridge log for that set. The Seatrawl data for this set is limited to only 11 good data points out of a possible 357 (one approximately every 5 seconds during the trawl). The other five sets noted had less than 32 good data points. The corresponding opening and clearance values reported below for these six sets appear reasonable and so it is not immediately obvious as to the true nature of the doorspread performance over the sets.

While there were only six sets, measured wingspread shows a consistent mean of from 13.5 m to 18.6 m. The mean wingspread is 16.4 m, compared with the 2001 value of 18.5 m.

Figures 3c and 3d present the opening and clearance statistics for each set. The mean opening is 5.1 m, comparable with 5.0 m in 2001 and 5.4 m in 2000. A number of sets were removed from this presentation of clearance due to large values calculated suggesting they are suspect. This included sets 15, 34, 44, 55,

and 70. In all instances the corresponding other net measurements appeared reasonable. The mean clearance for the remaining sets (those shown in Figure 3d) is 0.5 m, equal to the mean in 2001.

While there appears to be generally some good consistency in the opening, clearance, and wingspread measurements, the variability in doorspread, at least for several portions of the survey appears to be higher than is desirable. It is essential that the net performance should be carefully monitored in the future.

The vessel and gear are the same as previous years and there is nothing apparent in the 2002 survey measurements to suggest a drastic change in net performance. Nevertheless, a more detailed comparison of net performance and mensuration should be undertaken in the future. For the present though, the assumption is made here to use the same 60 ft wingspread value for the stratified analysis that has also been used for the other years. This is appropriate for preserving the six year relative index of abundance.

Age and Length Composition

Figure 4 presents the length composition of the 2002 survey and, for comparison, results from the 1997-2001 surveys are also shown. For 2002, the fish range in size between 32 cm and 113 cm. The distribution is centred over the 45 to 70 cm range, with a peak at 57 cm, and is shifted by about 8 cm to larger lengths from 2001. The distribution shows a marked similarity to that of 2001 with distinct length growth of the population while there is little in common with the populations of the earlier years.

Figures 5a to 5d present age composition of the 2002 sampled cod. Figure 5a presents length versus age distribution. The mean sampled length from the aged cod was 62.9 cm. Mean lengths for 1997 to 2001 were 63.5, 68.8, 63.9, 70, and 65 cm respectively. The maximum lengths sampled for years 1997 through 2002 were 103, 118, 108, 116, 111 and 114 cm. The mean sampled age for 2002 was 5.4 years. Mean ages for 1997 to 2001 were 5.8, 6.4, 6.1, 6.6, and 6.1 years respectively. The maximum ages sampled for years 1997 through 2002 were 12, 15, 13, 14, 16, and 13 and 12 respectively.

Figure 5b shows the percent occurrence of cod sampled at each age for the six years. The low representation of the weak 1991 year class is evident in all years as ages 6 through 11 for years 1997 to 2002 respectively. 2002 indicates the largest proportion of age 4 and age 5 fish although there are few fish at other ages compared to the other years.

Figures 5c and 5d present bar charts of the sampled numbers and percent occurrence of cod at age. A total of 422 otoliths were taken compared to the 502 in 1997, 450 in 1998, 551 in 1999, 678 in 2000, and 607 in 2001. The oldest cod was age 13.

Abundance and Biomass Estimates

Stratified Random surveys analysis was carried out using the DFO stratified analysis STRAP software and applying the French Exclusion Zone around St. Pierre et Miquelon for area calculations. As was the case for 1997 to 2001, a wingspread of 60 feet was used. Table 2a presents the STRAP output of estimated abundance and biomass. The estimated total number of cod for 3Ps is 38 million (with 95% confidence upper limit of 119 million). The mean number of cod per standard 1.5 nautical mile tow is 44.1 (with upper limit of 139 fish). The variances are large for the strap estimates which yielded negative lower limits: zero is shown in the tables. The estimated total cod biomass is 92.2 ktonnes (with upper limit of 291 ktonnes). The mean catch weight per tow is 107 kg.

Table 2b presents a summary comparison of these abundance and biomass STRAP estimates for 1997 to 2002. The 2002 abundance estimate of 37.9 million is comparable to the 44 million estimate of 2000 and almost identical to the 37.7 million estimate from 2000. The biomass estimate of 92.2 ktonnes is up slightly from the 2002 value of 82.7 ktonnes. This estimate is about half of the 2000 estimate of 187.2 ktonnes but is twice the 1998 and 1999 estimates and comparable to the first estimate of 99.3 ktonnes in 1997. The mean number of fish per set for 2002 is comparable to 2000's and down slightly from 2002. The mean catch per set values for 2002 is up slightly from 2001 but still less than half of the 2000 estimate.

Table 3a presents the STRAP age composition of numbers per tow, with sexes combined. The total mean number per tow is 44.1 (consistent with the values in Table 2a (44.1) and Table 1 (47.2)), with the greatest numbers expected at ages 4 (16.9 fish per tow) and 5 (18.5 fish). Ages 3 through 9 are the only ages with estimates of one fish (0.91 for age 9) or greater per tow. Table 3b presents a comparison of the estimated abundances and mean number of fish per tow for 1997-2002. The abundances are the greatest in 2002 for ages 4 and 5. The numbers of age 3 fish are less than 10% of the numbers seen in 2001 but are comparable with the other survey years. The numbers of age 4 fish are 62% of the 2001 values but much larger than an y of the previous years. The numbers of age 5 fish are the greatest of any of the years, and the age 6 numbers are also up slightly from 2001.

Tables 4a and 4b present the cod abundance and biomass estimates by strata for 1997 to 2002, arranged by depth regime. The overall abundance estimate (Table 4a) of 37.9 million cod is down by 14% from 2001 but is almost identical to that of 2000. While the shallower, less than 30 fathoms, strata in 2001 accounted for 87% of the 2001 abundance estimates, the 2002 contribution in these strata is about 2%. This amount is also less than half seen in any year. The 2002 estimates in the 31 to 50 fathom strata are generally comparable with other years. The 51 to 100 fathom range yields 89% of the total abundance estimate, due to the single large set in stratum 319. There were six sets in stratum 319 of catch weights 7020, 128, 60, 44, 3, and 1 kg. Historically, a large portion of the abundance

estimates have come from stratum 319. The deeper 101 to 150 fathom range yields an estimate of about 1.1 million cod, which is up by a factor of four and one half from 2001 but less than one quarter or less than the corresponding estimates of the previous years. In the final two strata groupings, the abundance estimates are a small fraction of the 1997 to 2000 estimates, although there are some fish in contrast to 2001 in which no cod were caught in these strata.

The biomass estimates presented in Table 4b show a similar trend compared with 2001, with the total biomass estimate up by almost 12%, although still just 49% of the 2000 estimate in which there were many more larger age 6 to 8, and 10 and 11 cod caught (e.g. Table 3b).

Figures 6a and 6b present the STRAP-estimated mean numbers per tow and percent occurrence of mean catch numbers per tow. The mean number of fish per tow are the greatest in 2002 for ages 4 and 5. Figure 6b shows that the percent occurrence of age 4 and 5 cod are all increased in 2001 from previous years, with the percentage of age 6 cod being comparable to that in 2001. The number of 4 and 5 year old cod account for 80% of the estimated catch.

Figures 7a and 7b present age composition by year class as opposed to age. In 2002 the 1998 and 1997 year classes clearly dominate the estimated total mean number of cod per tow and these numbers are up considerably from 2001. The number of 1996 year class in the 2002 survey are comparable to the previous three years. There are few 1995 year class or older cod in the 2002 survey estimate.

Figure 8a presents the total estimated cod abundance for each of the six survey years 1997 to 2002. Figures 8b and 8c present the estimated abundances by year class for year classes 1989 to 1998. Note the different abundance scales used in the graphs. The year classes are arbitrarily grouped together, taking those in succession and with similar magnitudes of abundance. Figure 8a illustrates the total abundance estimate increased steadily from 1998 to 2001 and has been of comparable magnitude for the past three years. As illustrated in Figure 8b, the numbers of cod 9 years or older has been dropping steadily since 2000 and estimates from 2002 are less than 1 million compared to values between 3 and 6 million in 2000.

Figure 8c does illustrate though that the 1997 and 1998 year class numbers have all increased since 2000. Aside from the age 4 population estimates in 2002, these two ages have by far the highest single populations of any seen in the six years of the survey (Table 3b).

Figure 9 presents the STRAP-estimated abundance at length values for both sexes for all survey years. For males, in 1997, the length distribution peak is the largest and most well-defined, and is centred between 58-73 cm. In 1998, the main distribution peak is greatly reduced, but centred about 60 cm as per 1997. A

smaller secondary peak is evident near 85-90 cm. In 1999, the overall magnitude of the distribution is comparable to 1998 (6.2M males in 1999 compared with 4.8M males in 1998), and the distribution shape is similar, although there is a shift in the peak from 64 to 70 cm. In 2000, the abundance estimates were back up to 17M males compared with 15.5M males in 1997, and the length distribution showed two peaks: one at 70-76 cm and extending to 1 m; and a second at 46 cm. In 2001, the distribution has changed markedly, with one prominent peak located between 40 and 60 cm, that being a four-fold increase over the peak already evident in 2000. In 2002, the distribution is a clear continuation of that seen in 2001 with peaks in the 55 to 62 cm range, 8 to 9 cm larger than in 2001.

Figure 10 presents the STRAP-estimated abundance at length values for all sexes combined for the six survey years 1997-2002. From 1997 to 1998 the data indicate a "bottoming out" of sorts, and in 2000 there was a visible increase in the length distribution peak from 1998 to 1999 to 2000, a consistent increase of approximately 6 cm each year from 61 cm in 1998 to 67 cm in 1999 to 73 cm in 2000. This increase disappeared in 2001 with there being few fish over 65 to 70 cm in length. The only evident growth now appears to be with the peak located at 49 cm in 2001 and now at 61 cm in the 2002 survey.

The 2002 survey indicates a total abundance estimate for 37.9 million cod which is down by 14% from the 2001 estimate of 44 million but is still consistent with the 2000 estimate of 37.7 million. The total biomass estimate for 2002 is 92 ktonnes which is up 11% from the 2001 estimate of 82.7 ktonnes but is still less than half the 187 ktonnes estimate of 2000. The larger 2000 biomass estimate is due in large part to increased numbers of larger cod, age 6 years and older, and in particular age 10 and 11, caught in 2000 that were not present in the 2001 or 2002 surveys. Nevertheless, the appearance of large numbers of smaller fish aged 3 and 4 in 2001 continued in 2002 with 80% of the estimated total abundance being attributable to age 4 and 5 year old cod. While most of the cod caught in 2001 were located in the shallower depths of the St. Pierre Bank, the greatest number of cod in the 2002 survey were located in the deeper mouth and entrance of Halibut Channel where most of the large catches of the earlier survey years were located.

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Table 1 Summary of Cod Catches for Stratified Random Survey Sets, NAFO Subdivision 3Ps, 23 Nov - 3 Dec 2002

M.V. Pennysmart Trip	Set	Year	Month	Day	StrLin	Division	Unit Area	Depth (m)	Set Location Lat (N)	Set Location Long (W)	COD Catch # of Fish	COD Catch Weight (kg)	Set Duration (min)	Tow Distance (n.mi.)	COD Mean Weight (kg)
7	1	2	11	23	322	3P	M29	129	46.54	55.68	2	2.0	30	1.5	1.0
7	2	2	11	24	322	3P	L29	133	46.52	56.04	1	1.5	30	1.5	1.5
7	3	2	11	25	310	3P	K29	243	46.93	57.14	4	7.0	30	1.5	1.8
7	4	2	11	25	310	3P	K29	211	46.87	57.19	17	30.0	30	1.5	1.8
7	5	2	11	26	311	3P	K29	138	46.82	57.14	2	3.0	30	1.6	1.5
7	6	2	11	26	314	3P	L29	48	46.67	56.99	0	0.0	30	1.6	
7	8	2	11	26	314	3P	K30	45	46.48	57.18	0	0.0	30	1.6	
7	9	2	11	26	312	3P	K29	60	46.60	57.32	1	3.0	30	1.6	3.0
7	10	2	11	26	705	3P	K29	351	46.64	57.67	0	0.0	30	1.6	
7	11	2	11	26	713	3P	K30	465	46.44	57.69	0	0.0	30	1.5	
7	12	2	11	26	713	3P	K30	473	46.22	57.83	0	0.0	30	1.5	
7	13	2	11	26	713	3P	K30	456	46.13	57.57	0	0.0	30	1.5	
7	14	2	11	27	705	3P	K30	335	46.34	57.41	0	0.0	30	1.6	
7	15	2	11	27	313	3P	K30	236	46.41	57.39	1	2.5	30	1.7	2.5
7	16	2	11	27	314	3P	K30	50	46.27	57.02	11	41.5	30	1.5	3.8
7	17	2	11	27	312	3P	K30	65	46.23	57.14	8	17.0	30	1.5	2.1
7	18	2	11	27	311	3P	K30	136	46.12	57.07	32	63.0	30	1.5	2.0
7	19	2	11	27	313	3P	K30	220	46.10	57.09	15	30.0	30	1.6	2.0
7	20	2	11	27	314	3P	L30	52	46.13	56.77	3	9.0	30	1.6	3.0
7	21	2	11	27	314	3P	L30	55	46.20	56.50	1	2.5	30	1.5	2.5
7	22	2	11	27	315	3P	L31	60	45.83	56.69	13	37.0	30	1.6	2.8
7	23	2	11	27	320	3P	L31	49	45.80	56.59	10	31.0	30	1.5	3.1
7	24	2	11	28	320	3P	L31	48	45.70	56.48	18	55.0	30	1.7	3.1
7	25	2	11	28	316	3P	L31	226	45.59	56.59	0	0.0	30	1.6	
7	26	2	11	28	316	3P	L32	223	45.39	56.43	1	1.5	30	1.6	1.5
7	27	2	11	28	317	3P	L32	116	45.44	56.42	4	13.0	30	1.5	3.3
7	28	2	11	28	320	3P	L31	46	45.55	56.10	16	46.0	30	1.6	2.9
7	29	2	11	28	320	3P	M31	46	45.50	55.83	4	11.0	30	1.6	2.8
7	30	2	11	28	320	3P	M31	47	45.56	55.69	4	11.0	30	1.6	2.8
7	31	2	11	28	321	3P	M31	69	45.60	55.48	82	215.0	30	1.5	2.6
7	32	2	11	28	321	3P	M31	62	45.66	55.57	14	62.0	30	1.6	4.4
7	33	2	11	28	320	3P	L31	47	45.81	56.07	5	17.0	20	1.0	3.4
7	34	2	11	29	321	3P	L31	58	45.95	56.04	2	9.0	30	1.7	4.5
7	35	2	11	29	321	3P	M31	70	45.99	55.86	2	4.0	30	1.5	2.0
7	36	2	11	29	321	3P	L30	68	46.11	56.04	2	4.0	30	1.6	2.0
7	37	2	11	29	322	3P	L30	142	46.32	56.05	1	1.0	30	1.6	1.0
7	38	2	11	29	322	3P	M30	154	46.35	55.64	3	3.5	30	1.6	1.2
7	39	2	11	29	322	3P	M30	131	46.23	55.49	3	2.5	30	1.4	0.8
7	40	2	11	29	322	3P	M30	130	46.20	55.29	2	10.0	30	1.7	5.0

Table 1 Summary of Cod Catches for Stratified Random Survey Sets, NAFO Subdivision 3Ps, 23 Nov - 3 Dec 2002 (continued)

M.V. Pennysmart Trip	Set	Year	Month	Day	StrLin	Division	Unit Area	Depth (m)	Set Location Lat (N)	Set Location Long (W)	COD Catch # of Fish	COD Catch Weight (kg)	Set Duration (min)	Tow Distance (n.mi.)	COD Mean Weight (kg)
7	41	2	11	29	324	3P	N30	157	46.32	54.75	2	4.0	30	1.6	2.0
7	42	2	11	29	324	3P	N30	117	46.22	54.51	3	2.5	30	1.5	0.8
7	43	2	11	29	325	3P	N30	82	46.05	54.55	1	1.0	30	1.5	1.0
7	44	2	11	29	325	3P	N31	68	45.94	54.76	1	1.5	30	1.5	1.5
7	45	2	11	30	323	3P	M31	153	45.97	55.06	1	1.0	30	1.6	1.0
7	46	2	11	30	323	3P	M31	159	45.78	55.22	2	3.0	30	1.5	1.5
7	47	2	11	30	323	3P	M31	158	45.70	55.22	3	5.0	30	1.5	1.7
7	48	2	11	30	325	3P	N31	80	45.62	54.72	2	1.0	30	1.5	0.5
7	49	2	11	30	319	3P	M32	122	45.43	55.01	2	3.0	30	1.6	1.5
7	50	2	11	30	325	3P	N32	82	45.38	54.71	0	0.0	30	1.6	
7	51	2	11	30	319	3P	N32	115	45.24	54.55	43	60.0	30	1.7	1.4
7	52	2	11	30	319	3P	N32	122	45.16	54.65	19	44.0	30	1.5	2.3
7	53	2	11	30	708	3P	N32	414	45.03	54.66	0	0.0	30	1.5	
7	54	2	11	30	318	3P	N32	201	45.09	54.83	58	120.0	30	1.6	2.1
7	55	2	11	30	707	3P	M32	308	45.09	55.14	2	11.0	30	1.5	5.5
7	56	2	12	1	319	3P	M32	171	45.24	55.14	50	128.0	30	1.5	2.6
7	57	2	12	1	319	3P	M32	146	45.17	55.37	2877	7019.9	30	1.5	2.4
7	58	2	12	1	315	3P	M32	69	45.29	55.60	7	13.0	30	1.6	1.9
7	59	2	12	1	315	3P	M32	72	45.33	55.70	9	24.0	30	1.5	2.7
7	60	2	12	1	315	3P	M32	88	45.17	55.72	3	15.0	30	1.5	5.0
7	61	2	12	1	315	3P	M32	78	45.09	55.78	2	1.5	30	1.6	0.8
7	62	2	12	1	707	3P	M33	301	44.93	55.61	0	0.0	30	1.5	
7	63	2	12	1	708	3P	M33	431	44.86	55.72	1	2.0	30	1.5	2.0
7	64	2	12	2	318	3P	M33	217	44.91	55.82	162	353.0	30	1.5	2.2
7	65	2	12	2	319	3P	M33	97	44.96	55.88	1	1.0	30	1.5	1.0
7	66	2	12	2	317	3P	L32	100	45.04	56.08	0	0.0	30	1.5	
7	67	2	12	3	711	3P	L32	400	45.22	56.65	0	0.0	30	1.5	
7	68	2	12	3	711	3P	L32	407	45.41	56.83	1	0.3	30	1.6	0.3
7	69	2	12	3	706	3P	L31	332	45.55	56.67	1	2.5	30	1.7	2.5
7	70	2	12	3	706	3P	L31	322	45.68	56.76	3	5.4	30	1.6	1.8
7	71	2	12	3	712	3P	K31	417	45.73	57.06	0	0.0	30	1.5	
7	72	2	12	3	712	3P	K31	453	45.72	57.42	0	0.0	30	1.5	
7	73	2	12	3	712	3P	K31	447	45.98	57.34	0	0.0	30	1.5	
7	74	2	12	3	713	3P	K30	414	46.06	57.32	1	0.5	30	1.6	0.5
7	75	2	12	3	706	3P	K31	303	45.98	57.04	2	2.5	30	1.5	1.3
7	76	2	12	3	314	3P	L30	47	46.29	56.83	0	0.0	30	1.5	
									Minimum		0.0	0.0	20.0	1.0	0.30
									Maximum		2877.0	7019.9	30.0	1.7	5.50
									Mean		47.2	114.3	29.9	1.5	2.19
									Median		2.0	3.0	30.0	1.5	2.00
									Standard Error		4.4	10.8	0.0	0.0	0.02
									Total		3543.0	8571.1			

Table 2a Stratified Analysis Estimated Cod Abundance and Biomas

COD GEAC 3PS 2002 No Zone
ANALYSIS FOR TRIP 7 2002 VESSEL 49 ICNAF 3P SPECIES 0438

NUMBERS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	21.00	10.50	9255.	97182.	84.50
311	2	33.88	16.94	17903.	303229.	453.76
312	2	8.94	4.47	16281.	72758.	24.94
313	2	14.94	7.47	11147.	83295.	86.86
314	6	14.81	2.47	61748.	152440.	18.67
315	5	32.63	6.53	52357.	341631.	18.06
316	2	0.94	0.47	11147.	5225.	0.44
317	2	4.00	2.00	11620.	23240.	8.00
318	2	216.38	108.19	8715.	942849.	5791.57
319	6	2986.82	497.80	66477.	33092356.	1358917.75
320	6	55.88	9.31	79988.	744990.	28.23
321	5	100.76	20.15	73503.	1481299.	1219.05
322	6	11.73	1.95	94648.	185022.	0.86
323	3	5.94	1.98	47020.	93061.	1.06
324	2	4.88	2.44	33374.	81348.	0.63
325	4	4.00	1.00	63775.	63775.	0.67
705	2	0.00	0.00	13174.	0.	0.00
706	3	5.69	1.90	28509.	54119.	0.94
707	2	2.00	1.00	4999.	4999.	2.00
708	2	1.00	0.50	8512.	4256.	0.50
711	2	0.94	0.47	37630.	17639.	0.44
712	3	0.00	0.00	49385.	0.	0.00
713	4	0.94	0.23	57492.	13475.	0.22

TOTAL	TOTAL UPPER	TOTAL LOWER	AVERAGE MEAN	AVERAGE UPPER	AVERAGE LOWER
37858180.	119240976.	-43524616.	44.09	138.87	-50.69

EFFECTIVE DEGREES OF FREEDOM= 5 STUDENTS T-VALUE= 2.57 ALPHA=0.05

WEIGHTS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	37.00	18.50	9255.	171225.	264.50
311	2	65.81	32.91	17903.	589114.	1811.27
312	2	19.81	9.91	16281.	161288.	100.64
313	2	30.33	15.17	11147.	169050.	335.90
314	6	52.44	8.74	61748.	539650.	268.28
315	5	87.28	17.46	52357.	913962.	157.78
316	2	1.41	0.70	11147.	7838.	0.99
317	2	13.00	6.50	11620.	75530.	84.50
318	2	465.50	232.75	8715.	2028405.	28920.13
319	6	7248.63	1208.11	66477.	80311056.	8108546.50
320	6	168.78	28.13	79988.	2250066.	258.21
321	5	288.82	57.76	73503.	4245763.	8253.42
322	6	19.22	3.20	94648.	303204.	8.27
323	3	8.94	2.98	47020.	140081.	4.13
324	2	6.25	3.13	33374.	104292.	0.78
325	4	3.50	0.88	63775.	55803.	0.40
705	2	0.00	0.00	13174.	0.	0.00
706	3	9.77	3.26	28509.	92830.	2.47
707	2	11.00	5.50	4999.	27496.	60.50
708	2	2.00	1.00	8512.	8512.	2.00
711	2	0.28	0.14	37630.	5292.	0.04
712	3	0.00	0.00	49385.	0.	0.00
713	4	0.47	0.12	57492.	6737.	0.05

TOTAL	TOTAL UPPER	TOTAL LOWER	AVERAGE MEAN	AVERAGE UPPER	AVERAGE LOWER
92207184.	291017952.	-106603576.	107.39	338.92	-124.15

EFFECTIVE DEGREES OF FREEDOM= 5 STUDENTS T-VALUE= 2.57 ALPHA=0.05

Table 2b Stratified Analysis Estimated Cod Abundance and Biomass: Comparison for 1997-2002

3Ps Cod Estimates						
"numbers"abundance (millions of fish)						
	95% upper limit	Estimated	95% lower limit	95% upper limit	Mean #fish /tow	95% lower limit
1997	57.1	30.9	4.8	97	52.6	8.2
1998 **	11.9	10.5	9.1	14	12.6	11
1999	20.7	13.7	6.7	24.9	16.5	8.1
2000 **	61.7	37.7	13.6	74.2	45.3	16.4
2001	79.6	44.0	8.3	91.5	50.5	9.58
2002	119.2	37.9	0	138.9	44.1	0
"weights" biomass (ktonnes)						
	95% upper limit	Estimated	95% lower limit	95% upper limit	Mean catch /tow (kg)	95% lower limit
1997	174.2	99.3	24.4	296	169	41
1998 **	56.8	47.9	38.9	68.3	57.5	46.8
1999	61.7	44.5	27.3	74.1	53.5	32.9
2000 **	324.5	187.2	50.0	389.9	225.0	60.0
2001	142.7	82.7	22.7	164.0	95.1	26.1
2002	291.0	92.2	0	338.9	107.4	0

** 75% upper and lower limits reported for 1998 and 2000
*** Note: variance too large for valid lower limits for 2002. Negative limit computed. Value of 0 reported.

Table 3a Stratified Analysis Cod Age Composition, Numbers per Standard Tow

COD GEAC 2002 3PS No Zone (S1 BY AGE)
ANALYSIS FOR TRIP 7 2002
VESSEL 49
ICNAF 3P

AGE COMPOSITION-NUMBERS PER STANDARD TOW

SUMMARY TABLE
SPECIES:SPECIES 0438
SEX:COMBINED

AGE IN YEARS	TOTAL NUMBERS	UPPER LIMIT	LOWER LIMIT	MEAN PER TOW	UPPER LIMIT	LOWER LIMIT	D.F.
0.0	0.	0.	0.	0.00	0.00	0.00	0
1.0	0.	0.	0.	0.00	0.00	0.00	0
2.0	0.	0.	0.	0.00	0.00	0.00	0
3.0	1083013.	2466178.	-300151.	1.26	2.87	-0.35	5
4.0	14494215.	45057052.	-16068620.	16.88	52.47	-18.71	5
5.0	15855152.	51226580.	-19516276.	18.47	59.66	-22.73	5
6.0	2487873.	8196738.	-3220992.	2.90	9.55	-3.75	5
7.0	1190742.	3864942.	-1483459.	1.39	4.50	-1.73	5
8.0	1013770.	3191599.	-1164060.	1.18	3.72	-1.36	5
9.0	782327.	2363756.	-799101.	0.91	2.75	-0.93	5
10.0	390842.	1265522.	-483839.	0.46	1.47	-0.56	5
11.0	74898.	235647.	-85852.	0.09	0.27	-0.10	5
12.0	227568.	678119.	-222982.	0.27	0.79	-0.26	5
13.0	258675.	736807.	-219458.	0.30	0.86	-0.26	5
UNKNOWN	0.	0.	0.	0.00	0.00	0.00	0
TOTAL	37859064.	119244144.	-43526012.	44.09	138.87	-50.69	5

ESTIMATION TYPE:STANDARD TRANSFORMATION TYPE:NONE
CONFIDENCE LEVEL: 0.95%
****-ONE OR MORE OF THE LOWER LIMITS IN THE ABOVE TABLE IS LESS THAN OR EQUAL TO ZERO.
VARIANCE IS TOO LARGE FOR VALID CONFIDENCE LIMITS ****

Table 3b Stratified Analysis Estimated Cod Abundance Year Class Distribution: Comparison for 1997-2002

	3Ps Cod Estimates											
	"number" abundance (millions of fish)						Mean #fish/tow					
Age (years)	1997	1998	1999	2000	2001	2002	1997	1998	1999	2000	2001	2002
1		0.01			0.03			0.01			0.03	
2	0.17	0.05	0.28	1.36	0.18		0.29	0.06	0.34	1.64	0.21	
3	1.93	0.33	0.95	6.03	10.85	1.08	3.28	0.40	1.14	7.24	12.47	1.26
4	5.55	1.47	1.43	2.38	23.26	14.49	9.42	1.76	1.71	2.86	26.74	16.88
5	8.02	1.93	2.35	2.79	3.27	15.86	13.62	2.32	2.83	3.35	3.75	18.47
6	1.78	1.51	2.98	4.31	1.86	2.48	3.02	1.81	3.58	5.18	2.14	2.90
7	5.91	0.29	2.73	4.90	1.41	1.19	10.03	0.35	3.27	5.89	1.62	1.39
8	7.05	1.36	0.43	3.32	1.17	1.01	11.97	1.64	0.51	3.99	1.34	1.18
9	0.79	2.83	1.19	0.95	0.84	0.78	1.34	3.40	1.43	1.14	0.96	0.91
10	0.32	0.33	1.13	4.85	0.09	0.39	0.54	0.40	1.36	5.83	0.10	0.46
11	0.14	0.04	0.14	5.94	0.38	0.07	0.24	0.04	0.17	7.14	0.44	0.09
12	0.02	0.11	0.08	0.66	0.50	0.23	0.04	0.13	0.10	0.79	0.58	0.27
13		0.18	0.01	0.09	0.07	0.26		0.22	0.02	0.11	0.08	0.30
14		0.00		0.14	0.04			0.00		0.17	0.05	
15		0.03			0.03			0.04			0.03	
16					0.01						0.02	

Table 4a Cod abundance estimates (thousands of fish) from GEAC surveys in NAFO Division 3Ps from 1997-2002

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 2 84 12-Dec 1997	Pennysmart 3 86 06-Dec 1998	Pennysmart 4 90 27-Nov 1999	Pennysmart 5 73 10-Dec 2000	Pennysmart 6 91 05-Dec 2001	Pennysmart 7 75 29-Nov 2002
<30	314	974	86	1111	138	5527	15972	152
	320	1320	4004	1540	1914	2760	22386	745
		Subtotal	4090	2651	2052	8287	38358	897
31-50	312	272	725	33	347	554	8	73
	315	827	2046	1456	3158	3304	446	342
	321	1189	175	189	250	73	127	1481
	325	944	50	11	52	16	104	64
	326	166	17	0	5	5	16	.
		Subtotal	3013	1689	3812	3952	701	1960
51-100	311	317	832	63	141	18	197	303
	317	193	226	331	126	494	30	23
	319	984	17410	370	833	10991	4135	33092
	322	1567	.	95	253	110	105	185
	323	696	225	47	18	0	176	93
	324	494	.	78	100	125	11	81
		Subtotal	18693	984	1471	11738	4654	33777
101-150	310	170	150	699	134	449	88	97
	313	165	443	167	1053	240	84	83
	316	189	3606	312	92	117	39	5
	318	129	339	3736	4959	12545	37	943
		Subtotal	4538	4914	6238	13351	248	1128
151-200	705	195	103	7	0	0	0	0
	706	476	513	29	10	19	0	54
	707	74	29	180	137	345	0	5
		Subtotal	645	216	147	364	0	59
201-300	708	126	.	9	17	25	0	4
	711	593	.	.	.	.	0	18
	712	731	.	0	0	0	0	0
	713	851	.	19	0	0	0	13
		Subtotal	0	28	17	25	0	35
	Total [1]		30,979	10,482	13,737	37,717	43,961	37,856

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.
. denotes strata not fished

Table 4b Cod biomass estimates (t) from GEAC surveys in NAFO Division 3Ps from 1997-2002

Depth range (fathoms)	Strata	Vessel / Trip / #Sets / Mean Date / sq. mi.	Pennysmart 2 84 12-Dec 1997	Pennysmart 3 86 06-Dec 1998	Pennysmart 4 90 27-Nov 1999	Pennysmart 5 73 10-Dec 2000	Pennysmart 6 91 05-Dec 2001	Pennysmart 7 75 29-Nov 2002
<30	314	974	262	7464	246	62730	25024	540
	320	1320	18907	5287	5276	4813	48280	2250
		Subtotal	19169	12751	5522	67543	73304	2790
31-50	312	272	1215	138	775	1123	7	161
	315	827	11171	4071	10443	22405	1019	914
	321	1189	301	559	962	87	151	4246
	325	944	89	55	113	8	327	56
	326	166	36	0	2	8	7	.
		Subtotal	12812	4823	12295	23631	1511	5377
51-100	311	317	1558	120	286	27	292	589
	317	193	957	938	336	598	164	76
	319	984	48133	1255	2455	22369	6498	80311
	322	1567	.	149	345	137	174	303
	323	696	341	103	31	0	258	140
	324	494	.	174	78	66	13	104
		Subtotal	50989	2739	3531	23197	7399	81523
101-150	310	170	263	1823	322	1039	170	171
	313	165	1132	458	2469	563	131	169
	316	189	12362	803	292	312	104	8
	318	129	911	23797	19561	69788	65	2028
		Subtotal	14668	26881	22644	71702	470	2376
151-200	705	195	277	11	0	0	0	0
	706	476	1317	118	33	43	0	93
	707	74	96	480	466	1019	0	27
		Subtotal	1690	609	499	1062	0	120
201-300	708	126	.	16	29	94	0	9
	711	593	.	.	.	.	0	5
	712	731	.	0	0	0	0	0
	713	851	.	57	0	0	0	7
		Subtotal	0	73	29	94	0	21
	Total [1]		99,328	47,876	44,520	187,229	82,684	92,207

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.
. denotes strata not fished

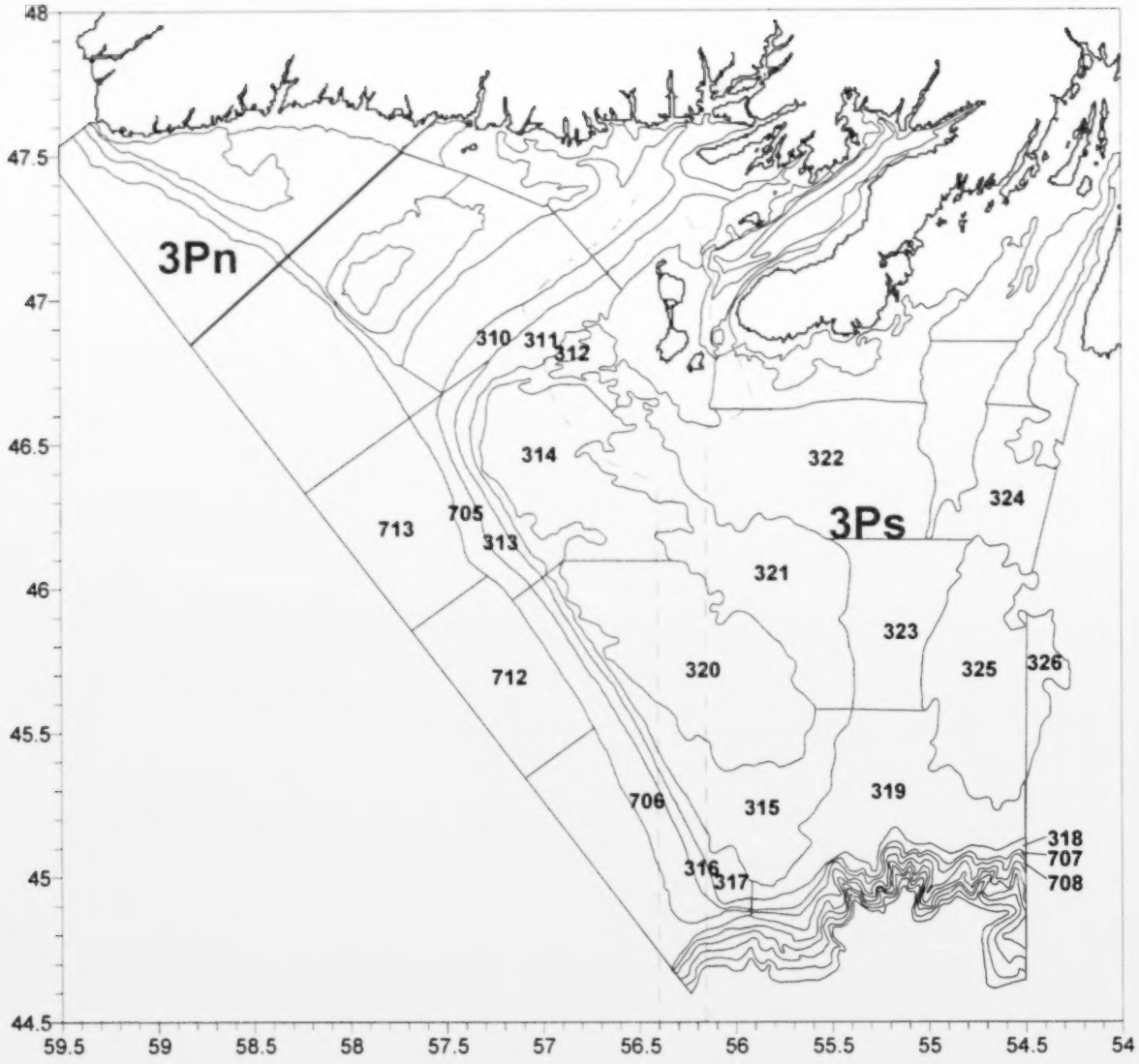


Figure 1 Stratum boundaries within NAFO Division 3P. Numbered strata indicate those surveyed during fall GEAC bottom trawl survey of Subdivision 3Ps. Dashed line is boundary of French economic zone which was not surveyed.

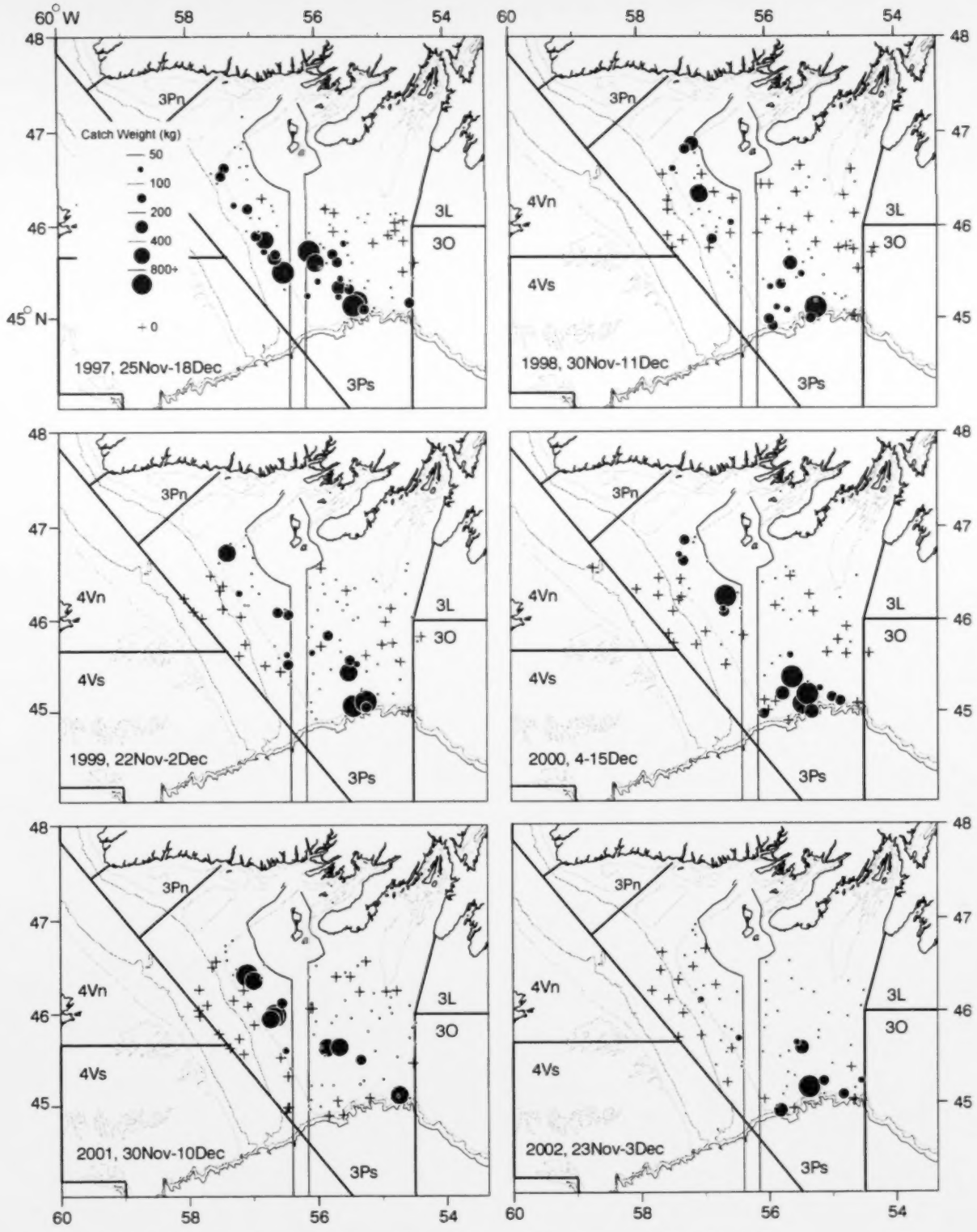


Figure 2 Cod Catch Weight Distribution from GEAC Stratified Random Surveys, 3Ps, 1997-2002. 200, 400, and 800 m depth contours are shown.

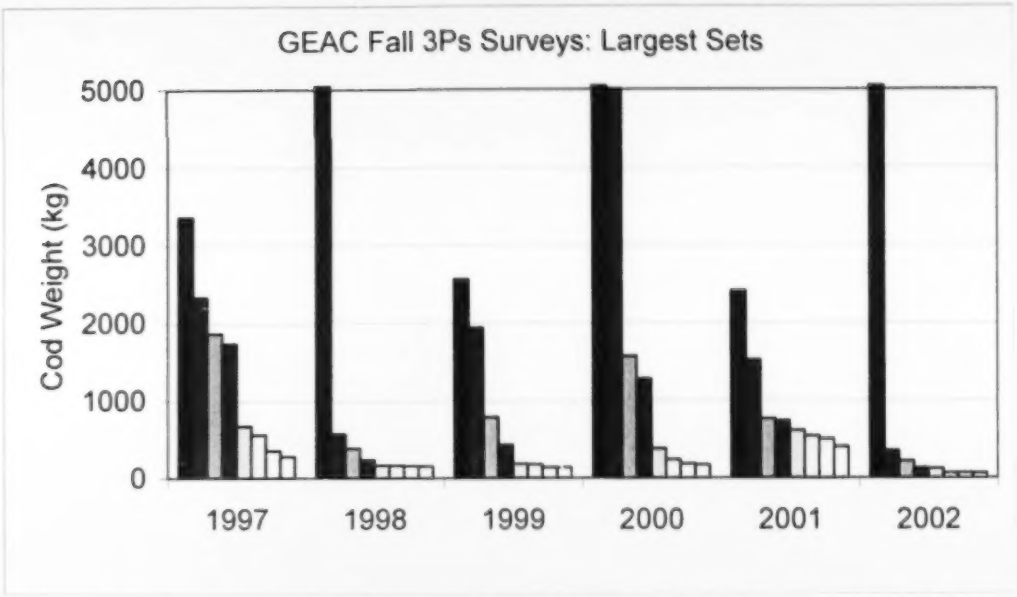


Figure 2a Largest catch set weights from GEAC Fall 3Ps surveys 1997-2002. (Largest sets in 1998, 2000, and 2002 are 8035 kg, 17083 kg and 5007 kg, and 7020 kg).

Figure 3a 2002 3Ps Survey Net Doors

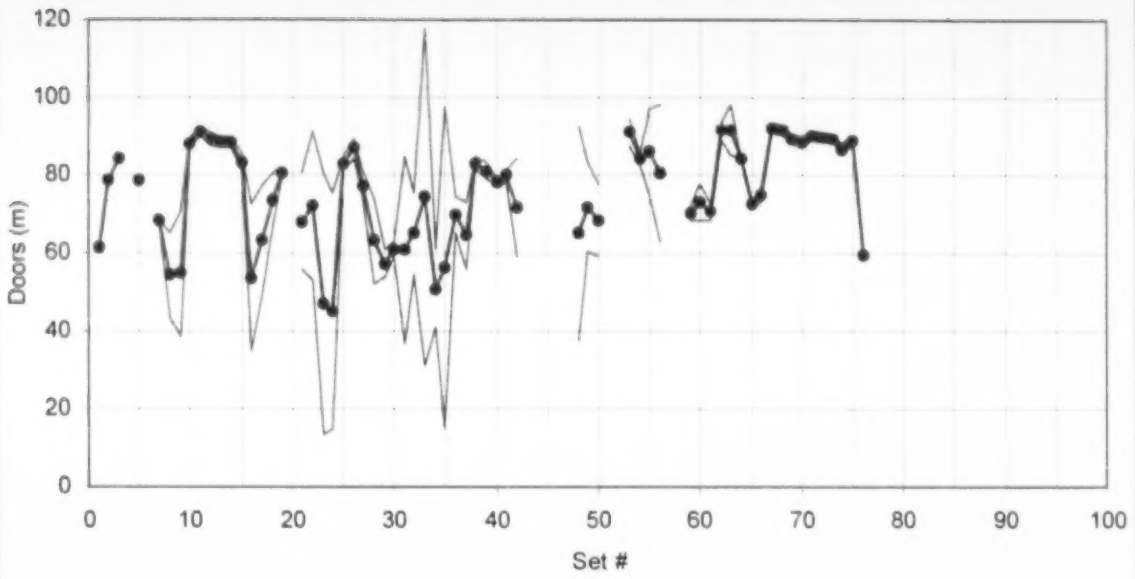


Figure 3b 2002 3Ps Survey Net Wings

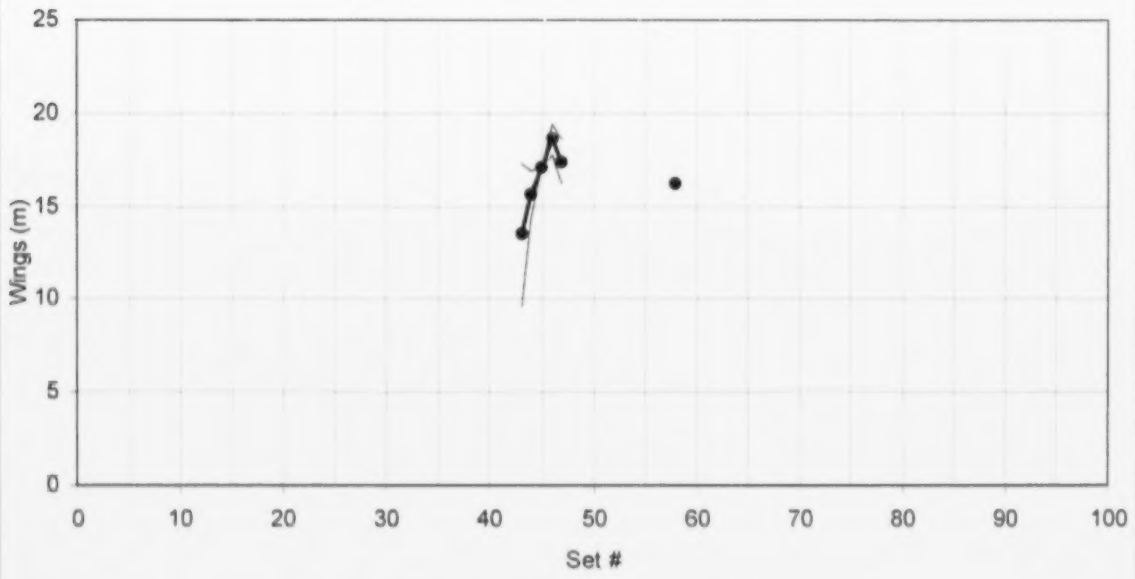


Figure 3c 2002 3Ps Survey Net Opening

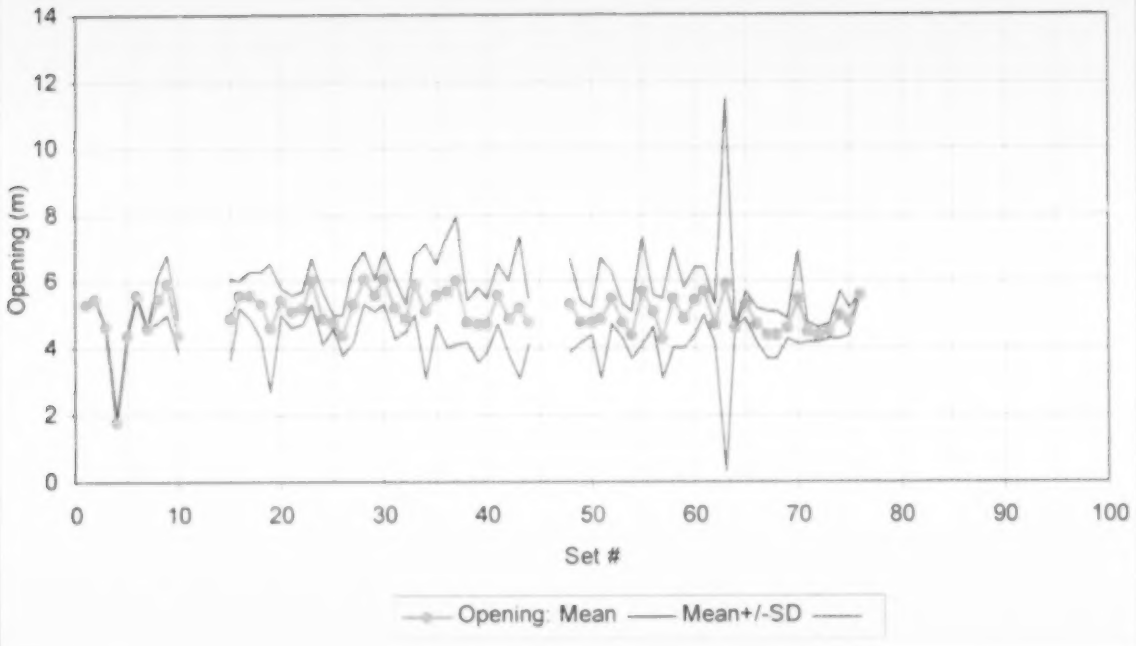


Figure 3d 2002 3Ps Survey Net Clearance

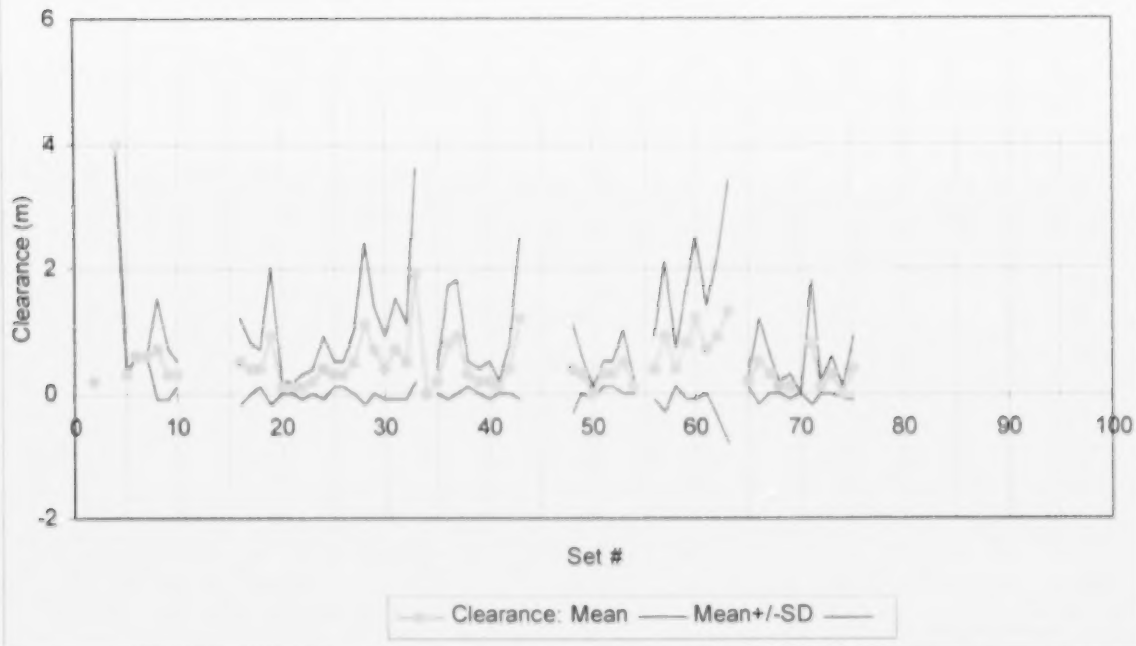


Figure 4 Length Composition of Cod
(3Ps Stratified Random Surveys 1997-2002)

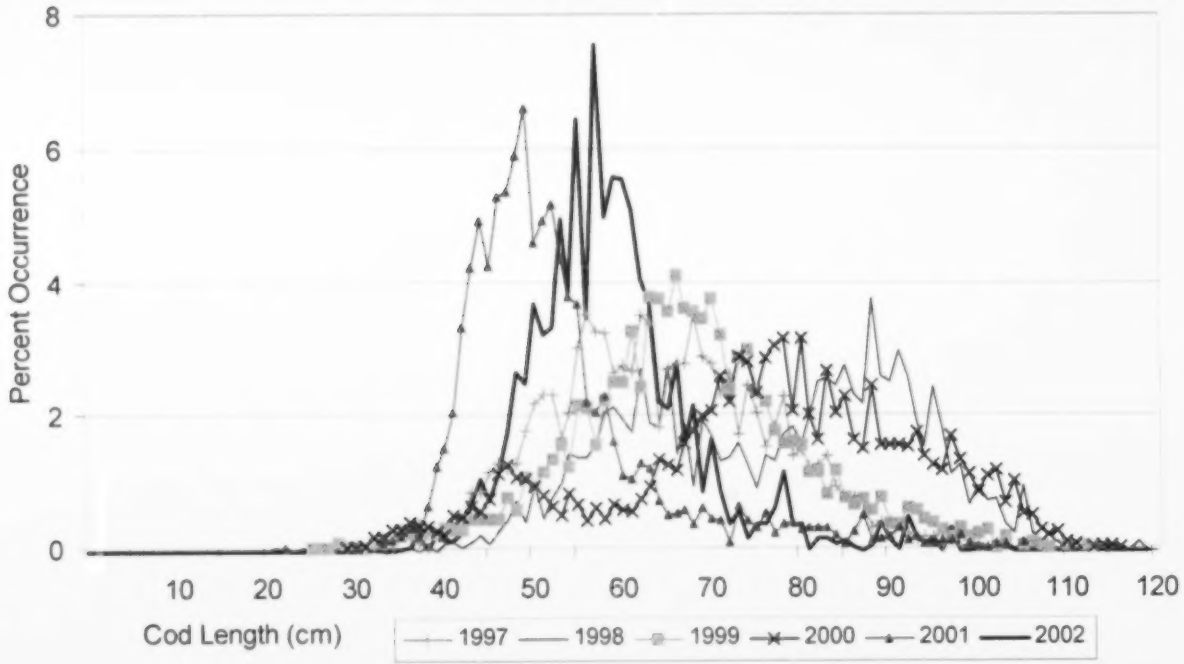


Figure 5a Cod Age-Length Composition
3Ps 2002 (422 samples)

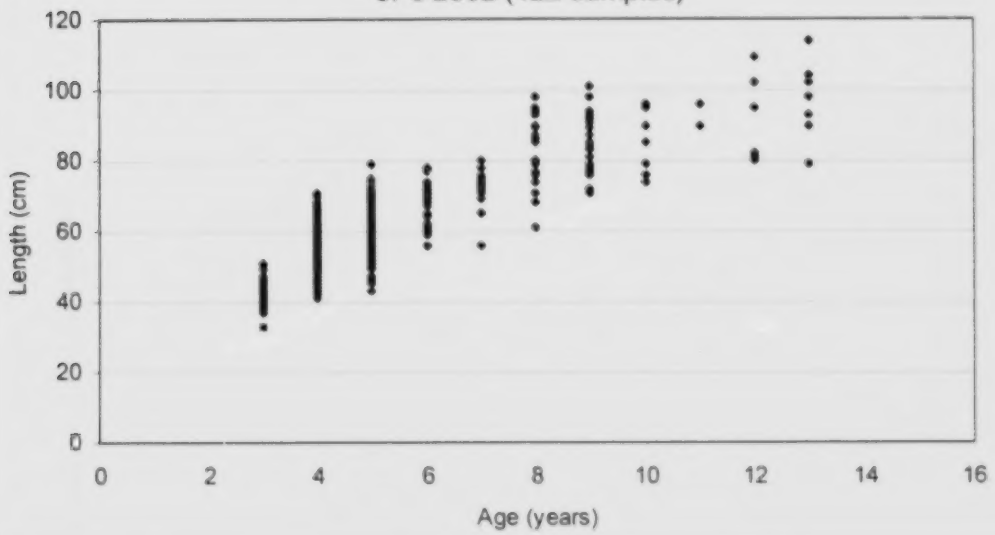
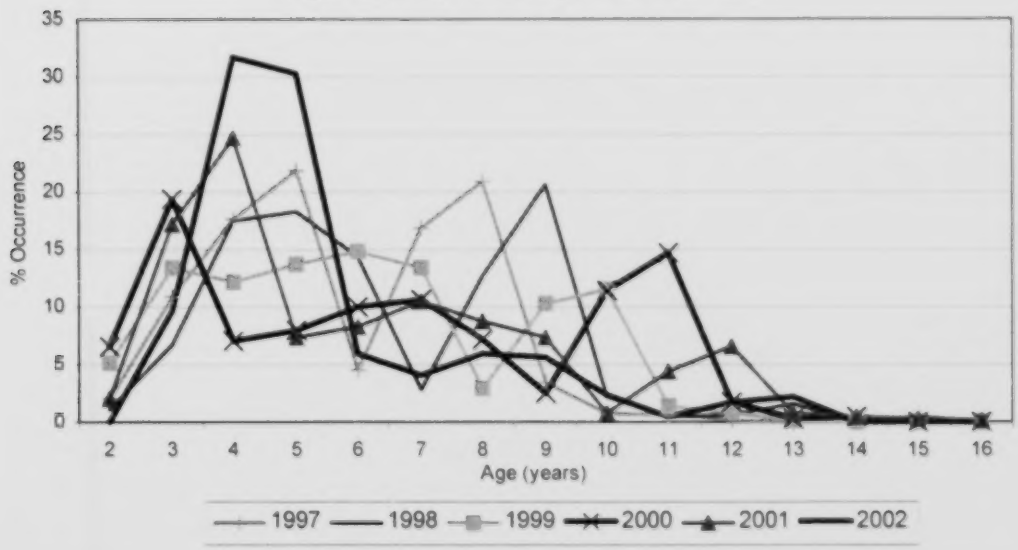


Figure 5b Sampled Cod Age Distribution, 3Ps



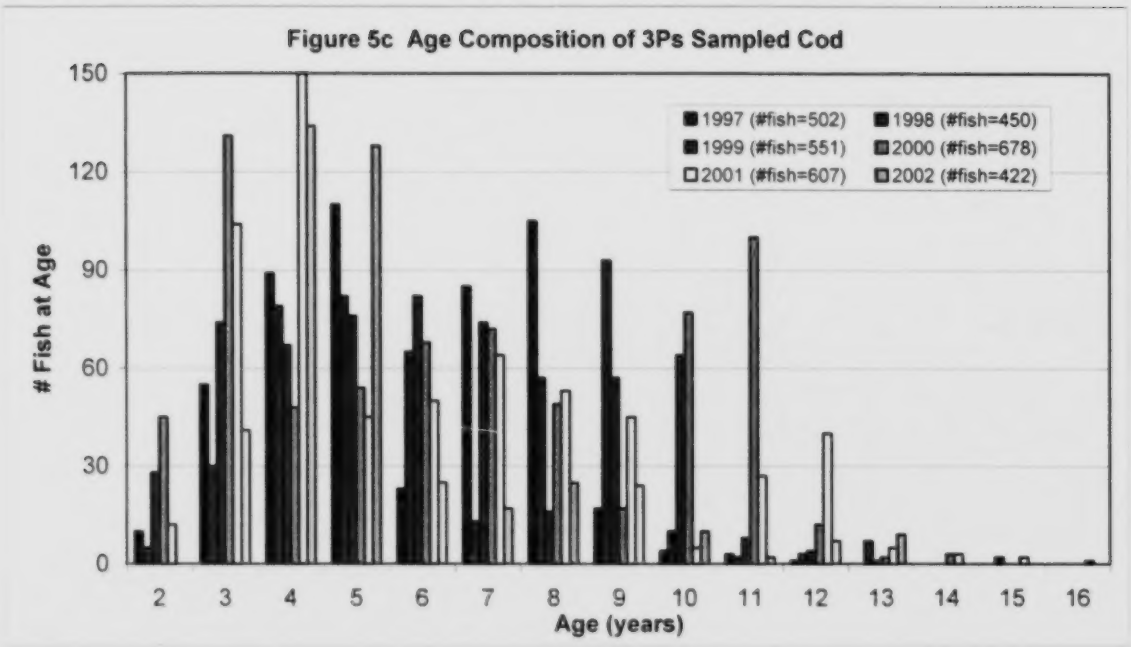


Figure 5c Age Composition of 3Ps Sampled Cod
Fish at Age
Age (years)
1997 (#fish=502)
1998 (#fish=450)
1999 (#fish=551)
2000 (#fish=678)
2001 (#fish=607)
2002 (#fish=422)

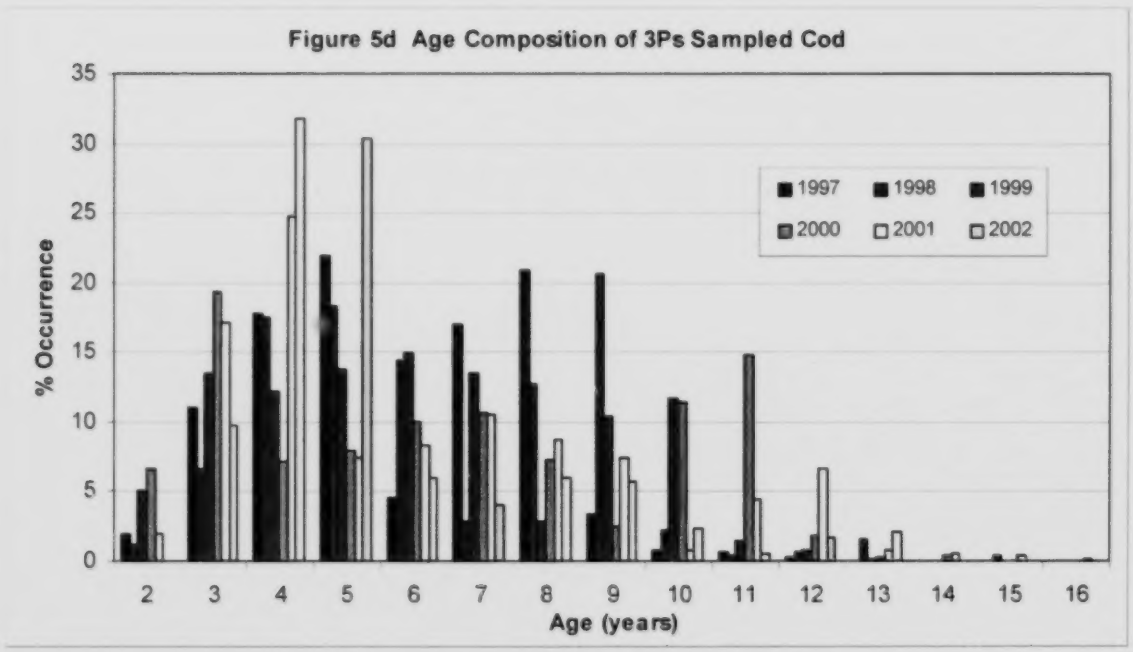


Figure 5d Age Composition of 3Ps Sampled Cod
% Occurrence
Age (years)
1997
1998
1999
2000
2001
2002

Figure 6a Age Composition of Cod, 3Ps, Estimated Mean #s per tow

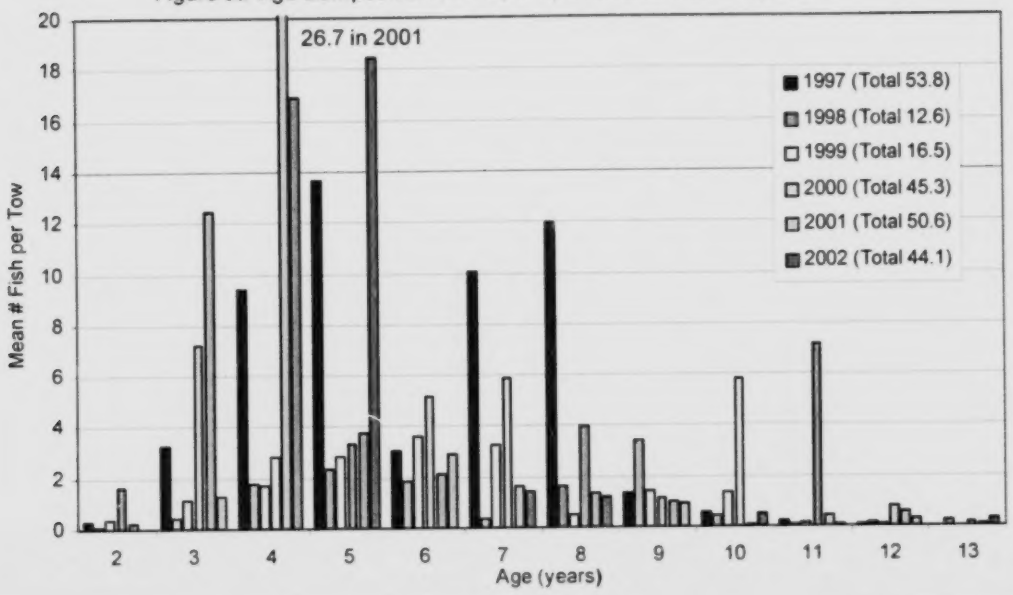


Figure 6b Age Composition of Cod, 3Ps, Estimated % of Total Mean #s per tow

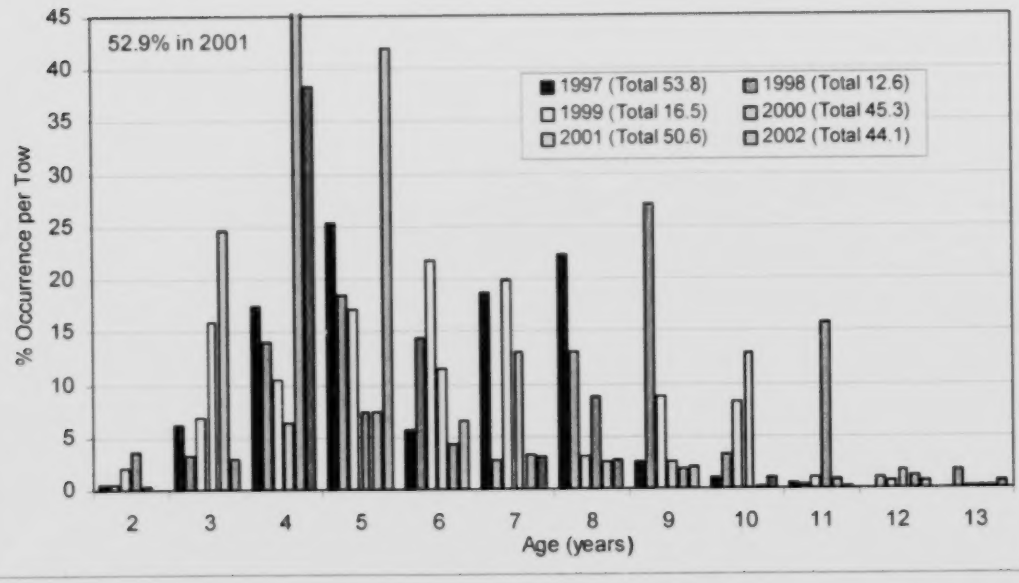


Figure 7a Age Composition of Cod, 3Ps, Estimated Mean #s per tow

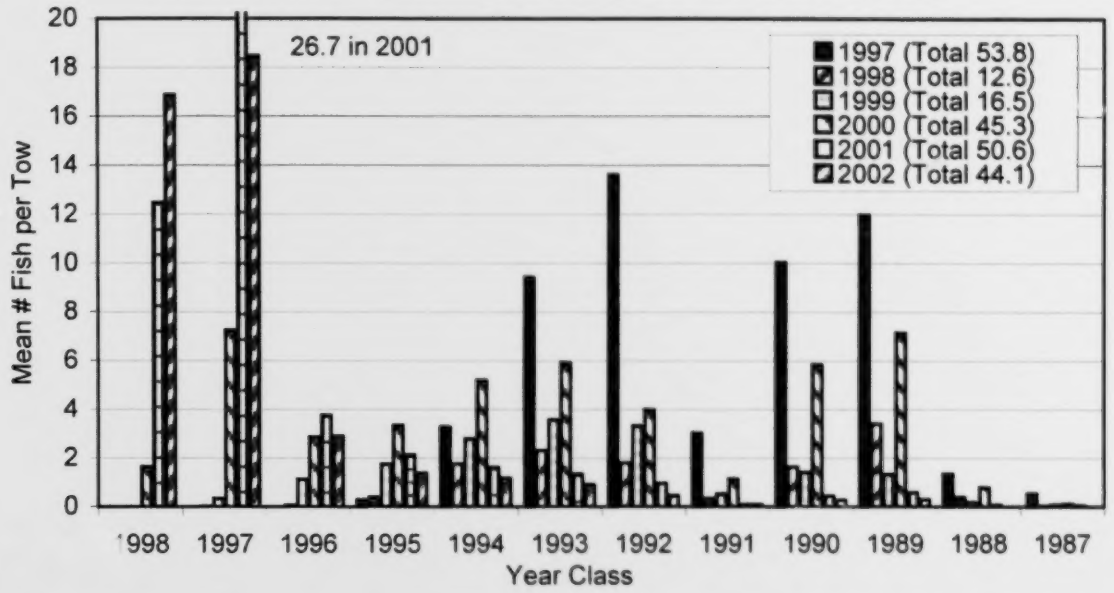


Figure 7b Age Composition of Cod, 3Ps, Estimated % of Total Mean #s per tow

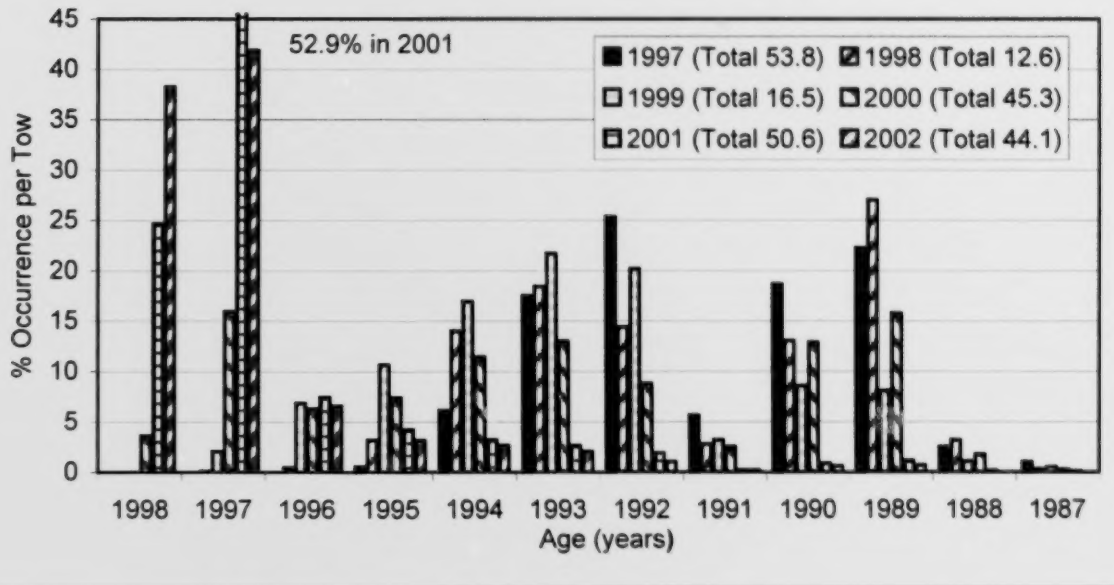


Figure 8a Estimated Cod Abundance, 3Ps, 1997-2002

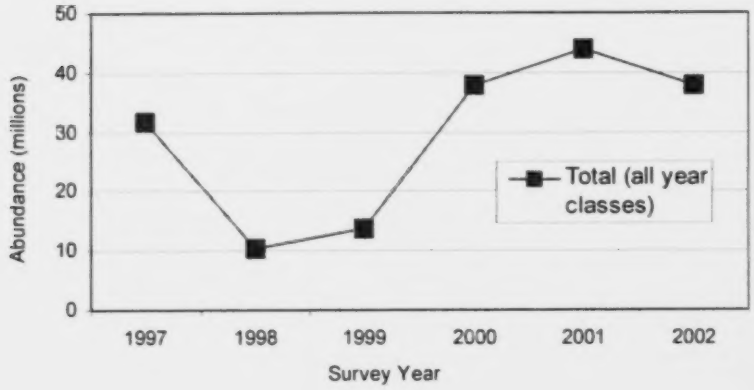


Figure 8b Estimated Cod Abundance, 3Ps, 1997-2002
1989, 1990, 1992 and 1993 year classes

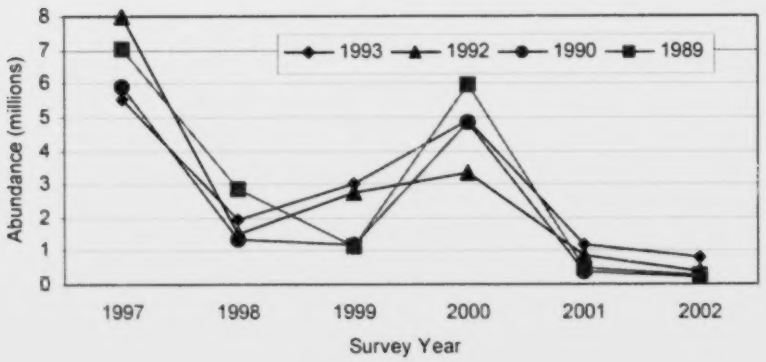
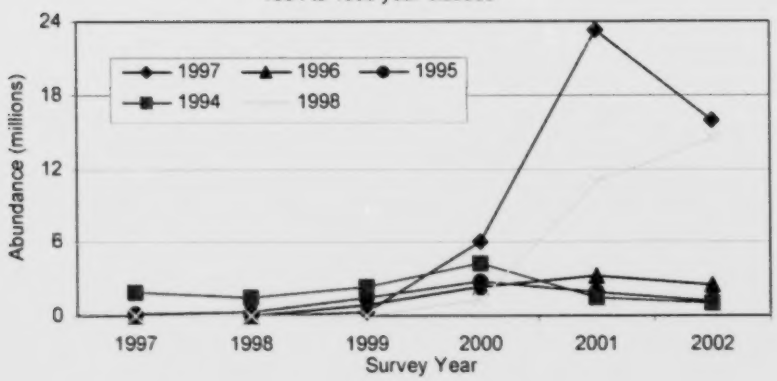
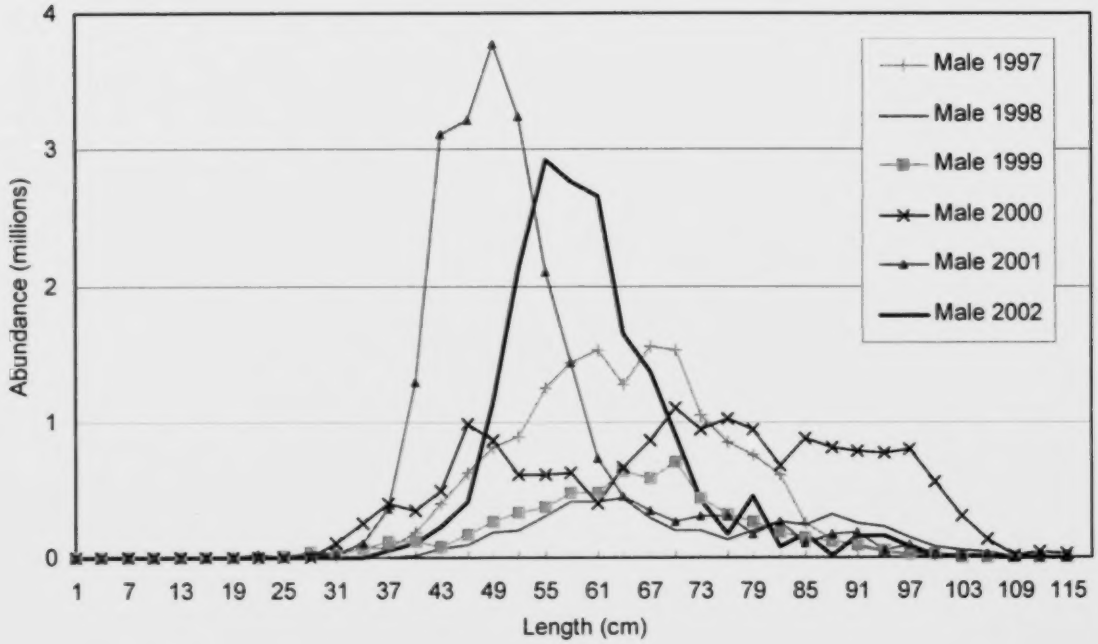


Figure 8c Estimated Cod Abundance, 3Ps, 1997-2002
1994 to 1998 year classes





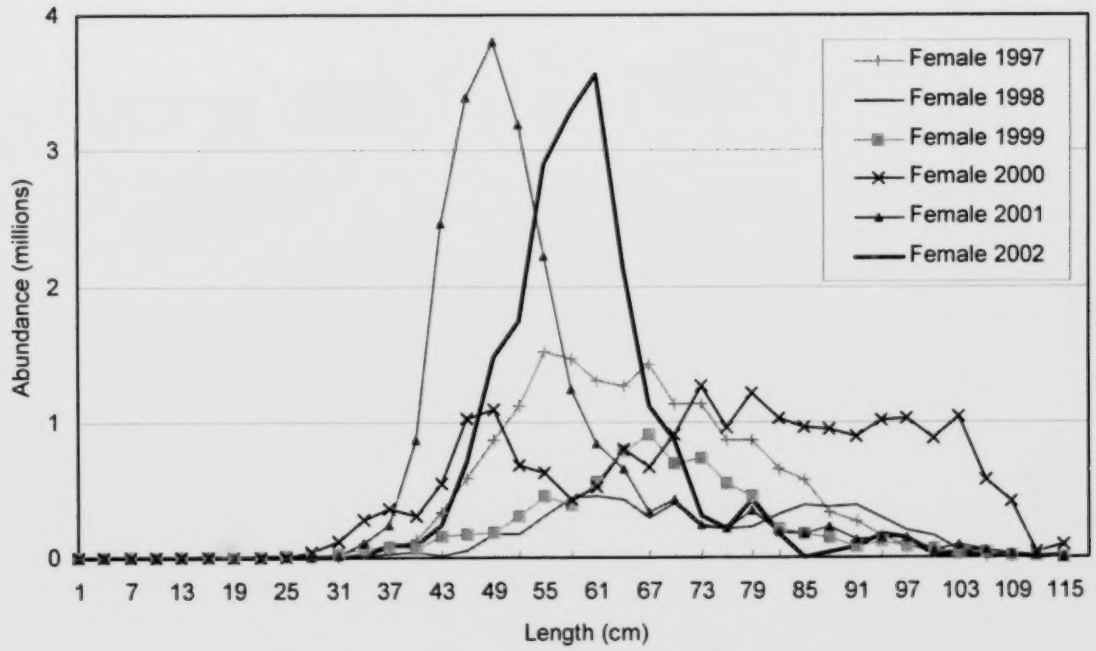


Figure 9 Cod survey abundance index at length from GEAC Industry surveys of 3Ps, 1997-2002. Distributions are shown for male and for female populations.

Figure 10 Cod Survey Abundance index at length, 3Ps, 1997-2002